Remarks

Reconsideration is respectfully requested in view of the above amendments and following remarks. Revisions of the specification are supported, for instance, at page 14, line 23 to page 16, line 7 and in Figures 2(A) through 2(E). Revisions of claim 6 are supported in the subject matter of previous claims. No new matter has been added. Claims 1-5, 9 and 13-15 are canceled without prejudice or disclaimer. Claims 6-8 and 10-12 are pending.

The specification is objected for not including a brief description of Figures 2(A) through 2(E). As suggested, the specification has been amended to include a brief description of Figures 2(A) through 2(E). The revisions are supported, for instance, at pages and in Figures 2(A) through 2(E). Withdrawal of the objection is respectfully requested.

Claims 1-5 and 13-15 are rejected under 35 U.S.C. 112, second paragraph, for being indefinite. The rejection is rendered moot, as claims 1-5 and 13-15 have been canceled. Applicants do not concede the correctness of the rejection. Withdrawal of the rejection is respectfully requested.

Claims 1-15 are rejected under 35 U.S.C. 102(b) as being anticipated by either Sircar (U.S. Patent No. 5,071,449) or Rouge et al. (U.S. Patent No. 5,891,218), or Gmelin et al. (U.S. Patent No. 5,228,888 or Hirooka et al. (U.S. Patent No. 5,122,164). Applicants respectfully traverse this rejection, and respectfully request reconsideration in view of the following comments.

Claim 6 recites an adsorbent column packed with an adsorbent where the column is formed such that a superficial velocity is set to be within a range of ±25% of $u = 0.07a + 0.095$ ("a" being the diameter of the adsorbent). The adsorbent column of claim 6 provides advantageous results, including superior performance of the pressure swing adsorption separation to that of conventional columns that determine the diameter of the column based on the shape characteristics of the selected adsorbent (page 7, lines 16-22 and page 18, lines 19-23).

Sircar is directed to improving the pressure swing adsorption (PSA) process by using a shallow adsorbent layer loaded with small adsorbent particles so as to permit moderately fast cycling of the adsorption and desorption steps of the PSA process. The shallow adsorbent layer is defined by a determined ratio of the diameter (D) of the adsorbent layer to its height (L) as D/L (col. 3, lines 24-35).

Rouge et al. is directed to limiting pressure drops taking place within an adsorbent bed and maintaining the constant performance of a PSA unit by decreasing the thickness of the adsorbent bed. The dimensioning of the adsorbent bed thickness according to Rouge et al. is determined by the ratio of ($e/\sqrt{d}$), where e represents the adsorbent bed thickness and d represents the mean granulometry of the adsorbent particles (col. 2, line 40 to col. 3, line 30).

Gmelin et al. is directed to a single adsorption column containing crushed kinetic zeolite sieve material as an adsorbent having a particle size of 10-40 mesh, and intends to provide an economical and simple air separation system. By using the crushed molecular sieve material, a short duty cycle can be employed to alternatively deliver a nitrogen product stream from pressurized air passing through the adsorption column and to back flow the column to depressurize the same through its inlet (col. 1, line 38 to col. 2, line 2 and col. 3, lines 8-10).

Hirooka et al. is directed to a two bed PSA process using relatively fine particles of zeolite sieve material, as an adsorbent, at short cycle times of less than 40 seconds to gain good usage of the sieve material. Hirooka et al. intends to provide an improved PSA process with high yield and high production rate (col. 1, line 42 to col. 2, line 5).

However, the cited references do not teach or suggest the features of claim 6. In fact, the cited references do not disclose or suggest an adsorbent column having a configuration where the column is formed such that a superficial velocity is set to be within a range of ±25% of $u = 0.07a + 0.095$ ("a" being the diameter of the adsorbent), as required by claim 6. For at least these reasons, Sircar, Rouge et al., Gmelin et al. and Hirooka et al. do not anticipate claim 6.

Furthermore, as the cited references do not teach or suggest the features of claim 6, there also is no reasonable suggestion the cited references would lead to any advantages provided by the features of claim 6. The present invention provides advantageous results from its configuration including superior performance of the pressure swing adsorption separation process to that provided by conventional columns. There is nothing in the cited references suggesting a configuration for an adsorbent column where the adsorbent column is formed, as recited in claim 1, as a relationship with an adsorbent of varying sizes and shapes, in providing an optimum shape of the column with improved performance. For at least these reasons, claim 6 is patentable over Sircar, Rouge et al., Gmelin et al. and Hirooka et al.

Additionally, claims 7-8 and 10-11 depend upon and further limit claim 6. Claim 12 is directed to a pressure swing adsorption apparatus, and includes at least some of the subject matter of claim 6 discussed above. Accordingly, it is respectfully submitted that these claims also are patentable over the cited references for at least the reasons discussed above with respect to claim 6.

Favorable reconsideration and withdrawal of the rejection are respectfully requested.

With the above amendments and remarks, Applicants believe that this patent application is in a condition for allowance. Favorable consideration is respectfully requested. If any further questions arise, the Examiner is invited to contact Applicants' representative at the number listed below.

Respectfully submitted,

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Version With Markings Showing Changes Made to Application Serial No. 09/858267

In the Specification:

(Amended) FIG. 2 is a drawing represented by Figs. 2(A) through 2(E) showing an example of the PSA process according to the present invention;

Fig. 2(A) is a drawing showing a repressurization/product recovery step of the PSA process according to the present invention;

Fig. 2(B) is a drawing showing a pressure equalization step of the PSA process according to the present invention;

Fig. 2(C) is a drawing showing a vacuum regeneration step of the PSA process according to the present invention;

Fig. 2(D) is a drawing showing a purge regeneration step of the PSA process according to the present invention;

Fig. 2(E) is a drawing showing a pressure equalization step of the PSA process according to the present invention;

In the Claims:

6. (Amended) An adsorption column ~~for a pressure swing adsorption separation column,~~ packed with an adsorbent for separating and collecting ~~an objective component gas~~ oxygen from an air ~~from a multi-component gas mixture~~ by a pressure swing adsorption separation process~~,~~ ~~said~~ comprising: an adsorption column that is formed such that a superficial velocity u [m/s] is set to be within a range of ±25% of u = 0.07a + 0.095, wherein "a" [mm] being the diameter of the adsorbent ~~comprising:~~

~~said adsorbent comprising particles having a size,~~

~~wherein said size of said particles of said adsorbent is established such that a diameter~~ in case of said particles of said adsorbent having a spherical shape, or an equivalent diameter in case of said particles of said adsorbent having a cylindrical shape, an elliptic spherical shape or an elliptic cylindrical shape~~, is supposed to be a [mm], and a superficial velocity u[m/s] is set to be within a range of ±25% of u = 0.07a + 0.095~~.